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DEPARTMENT OF AGRICULTURE OF THE PROVINCE OF QUEBEC

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A short study on Cereals

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INTRODUCTION

The cultivation of edible grains is indispensable on all farms where stock-breeding is carried on. In fact, experience shows that it is impossible to breed animals if all the food consumed by them is not grown on the farm.

We produced oats in sufficient quantity until late years, but wheat, barley, rye and buckwheat are not so extensively cultivated. Such a state of things must be remedied without fail, if we wish to carry on practical farming.

But it is not enough to wish to grow grain; the means to be taken in order to obtain the greatest yields, must also be known. Many farmers lack knowledge in this respect, and are content with a crop below the average while, with a good system, it might easily be increased from 15 to 25 bushels per acre, by adopting appropriate methods. Take oats for instance; the average yield of which is from 25 to 35 bushels, per acre. Now, it has been proved by positively convincing experiments that, with proper tillage, from 55 to 70 bushels per acre can be obtained. In both cases it is necessary to plough, harrow, sow and cut the grain when it is ripe. But, the farmer who harvests from 55 to 70 bushels, will plough better, harrow until the soil is quite crumbled, roll it when needed, sow at the proper time and use good seed; he will also take the precaution to select beforehand the piece of land most suitable for growing oats, have a good rotation system and be careful to thoroughly drain his land.

The above may apply, with proper proportions, to the cultivation of wheat, barley, rye and buckwheat which are in the category of edible grains.

It is for the purpose of helping the farmers of this Province to get better yields from their grain crops, that I have written this bulletin. The question here is not to make a complete study of cereals, but to demonstrate the fundamental principles on which grain-growing is based.

I have prefaced these notes with some essential data relating to botany. In fact, if one wishes to give them all the care they need, it is important to thoroughly know how plants get their food, how they develop, what are their principal organs and how such organs vary with the different species.

Then come matters relating to the tillage of wheat, oats, barley, rye and buckwheat, and, in conclusion, the principles to be followed in seed selection.

WHEAT

Wheat-growing, formerly so extensively carried on in the Province of Quebec, has greatly fallen off for some years. This is attributed to two principal causes:

1. The rapid development of Western Canada which has almost totally monopolized its production.

2. The damage caused by a small insect called the "Hessian Fly" which attacks the stem causing it to lodge prematurely.

In fact, as everybody knows, the tillage of the vast western prairies was a revelation of the fertility of the virgin soil enriched for centuries by the accumulation of vegetable and animal detritus. Wheat-growing in that region increased from year to year until the economic crisis caused by its exceedingly rapid development. Since then, the war in Europe has created an immense market for Canadian wheat. As a result of this, the greater portion of the western crop goes to Europe and we are compelled to increase our production to supply the needs of our local consumption and remedy the increasing cost of flour and bread.

The second cause, namely: the ravages of the Hessian Fly, hardly exists in the Province of Quebec at present. The chief reason was the decrease in wheat-growing; the insect disappeared as the source of its food was gone.

Wheat-growing is becoming a problem of the highest importance in our Province and there is no longer any reason for neglecting it.

The experiment made by our farmers during the war convincingly proves that we can grow wheat of the very best quality and in abundance in many parts of the Province. It suffices to adopt a good method of tillage and to use choice seed. Such an agricultural region as ours should produce enough wheat to feed its population.

OATS

It is related that Samuel Johnson, the English author, while conversing with a man from the land of the thistle, who tried to convince him of the value of oats as food, said: "Oats ! Why in England we feed our horses on them." "That", quietly replied the Scotchman, "explains why the best horses came from England and the best men from Scotland."

This simple and accurate reasoning clearly shows the importance which the inhabitants of North Britain attach to oats as food for human beings. In fact, in the northeast part of Scotland it is not unusual to find strong and healthy farm hands whose daily food, in summer time, consists merely of two and a half pounds of oatmeal porridge and three or four pints of milk.

Many years ago our farmers began to eat that porridge at their morning and evening meals. This custom spread gradually and we now have porridge eaters in all ranks of society. Physicians strongly recommend it, especially for dyspeptic and anemic persons. It is, moreover, very pleasing to the taste when properly prepared.

Among live stock, the horse is the greatest consumer of oats. This explains the extensive cultivation of oats in our Province, since horses have almost completely replaced oxen for farm work. In fact, the Province of Quebec produces as much oats as all other cereals combined. The great facility of cultivating it, its adaptation to the most different soils and, above all, the ideal climate of Quebec, have made it so popular with our farmers.

BARLEY

Barley, which is not grown to the same extent as wheat and oats, has nevertheless its own importance and ranks amongst the best cereal crops. Moreover, its use has a tendency to become more general and it is now used as food both for human beings and for animals. In addition to this, it is the chief ingredient in brewing beer.

RYE AND BUCKWHEAT

The growing of these two cereals may be said to be a secondary matter. Their cultivation, which was formerly done on a large scale, has fallen off considerably at present. This is due to their inferior quality as a crop and to the ever-increasing importance, for some years past, of wheat and oats as food for human beings.

More perfect tillage methods as well as improved agricultural implements now used on most Canadian farms, have also contributed to making them less popular. As tillage methods improved and land value increased, it became necessary to grow crops from which greater profit could be derived.

I was at a seed grain exhibition one day and, among the finest exhibits on a wall, I noticed a large drawing representing a bushel measure. On each stave of the bushel were written the different tillage methods that contribute to the production of large crops such as: rotation, drainage, fertilizers, ploughing, harrowing, etc. The staves bearing these inscriptions were all solidly attached. The last one, on the contrary, was broken at the bottom allowing the contents of the measure to escape This stave was marked: "BAD SEED."

The information intended to be conveyed by this drawing is very significant It clearly shows how useless all tillage methods are when good seed is not used.

IT IS OF NO AVAIL TO PROPERLY PREPARE THE SOIL, TO FERTILIZE IT, TO USE THE MOST IMPROVED IMPLEMENTS, OR TO PRACTISE A WELL ARRANGED ROTATION, IF THE SEED USED IS DEFECTIVE.

Essential Notions on Botany

Every living plant has two main sources of nourishment, the **Soil** and the **Air**.

From the soil, the plant draws the necessary organic and mineral matter, in a soluble or liquid form. Thus *potash*, *phosphoric acid*, *nitrogen* and a little *carbon* pass into the absorbing hair or filaments of the roots, thence to be carried on to the parts requiring them.

The elements which the plant receives from the air are especially *oxygen*, *hydrogen*, much *carbon*, and *nitrogen* in the case of leguminous plants (1). A certain amount of oxygen is absorbed through the roots, but most of it comes from the air.

This nourishment once obtained undergoes certain transformations in its process through the various parts of the plant.

The essential object of every plant is to reproduce itself, and this is done by means of the seed. Hence it requires organs whose cooperation will produce this object. These organs are the **Roots**, the **Stem**, the **Leaves**, the **Flowers** and the **Seeds.**

ROOTS

The functions of the roots are :

1.—To absorb nourishment from the soil in a liquid form ;

2.—To render assimilable such nourishment by dissolving particles which have remained solid;

3.—To store up nourishment for the plant's future wants ;

4.—To serve as a support for the plant and keep it steady.

These functions are fulfilled by roots varying in form with each kind of plant. The principal ones are the following :

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(1) Leguminous plants are those which have the property of accumulating in their roots the nitrogen from the air.

I. TAP-ROOTS

They consist of a vertical branch called tap from which grow out horizontal roots or rootlets. These rootlets carry the nutriment absorbed by the absorbing hair or filaments which surround them. The tap may also serve as a stem for the plant, in which case it accumulates alimentary substances for the future.

Example : — Roots of carrots, beets, swedes, clover, alfalfa, peas, beans, etc.....

II. FIBROUS ROOTS

In these the tap is so ramified that it disappears in a mass of roots of about equal length which all shoot out from the same point. Each one of them carries the nutriment absorbed in the lower node of the stem. Plants with a root of this shape reach their full growth and ripen their seeds in a season.

Example :—Roots of wheat, barley, oats, rye and certain fodder grass.

III. RUNNING ROOTS

The hardiest plants have this kind of root. Each cluster of roots throws out runners in every direction; the latter in turn develop new clusters whence the stems spring. Plants having this kind of root fill up the clear space around them and often succeed in choking up the surrounding plants.

Example :—Couch grass.

Lastly there exists a kind of roots called secondary roots. Their function is not so much to nourish plants as to help them to stand upright. They grow out from the lower nodes and fasten to the soil like the rigging of a ship. The high-growing varieties of corn are provided at their base with such supporting roots.

STEM

The stem of the plant contains vessels which serve as a channel for the ascending and descending sap. In certain plants, like root plants, it is solid; in others, it is hollow with nodes at scattered intervals.

LEAVES

The leaves are the plant's breathing and digestive apparatus. They breathe through openings (stomata) situated on the inside and absorb carbon from the air during the day and oxygen at night. Moreover, under the influence of light they absorb through their roots, nourishing substances which they afterwards return to such portions of the plant as are in need thereof.

FLOWERS

The flowers contain the reproductive organs of the plant and are formed when the latter is full grown. They consist of a more or less large number of stamens (male organs), according to the kind of plant, and of a pistil (female organ) which may be single or compound. When the pollen contained in the anther of the stamen falls on the stigma of the pistil, there is fecundation of the flower and the product is a *fruit* or *seed*, containing in a latent state, all the energy needed to develop another plant of the same kind.

If fecundation results from the cooperation of a pollen seed with the pistil of the same flower, the plant thus developed will be absolutely identical with the mother plant. If, on the other hand, the pollen comes from a plant of a different variety, the product will be a crossed seed capable of developing a plant whose characteristics will resemble the mother plants of both varieties. *There is no crossing possible except between varieties of the same species.*

GERMINATION

Any seed normally developed has the necessary energy to germinate in the following way:—

1.—The seed absorbs the moisture from the soil and swells ;

2.—The solid matter which it contains changes into a liquid state;

3.—Starch and fatty matter turn into sugar;

4.—The germ bursts at last from its integument and grows roots and a stem.

CONDITIONS FOR GOOD GERMINATION

For proper germination the following is necessary.

I.—That the seed be sound in all its parts ;

II.--That the integument be permeable by water ;

III.—That the kernel be ripe inside ;

IV.—That the seed preserve its germinating faculties ;

These conditions are very important and should be attended to by all farmers anxious to gather good prolific grain. Productivity, however, does not suffice alone to develop a good plant. The soil must also be sufficiently moist, contain enough appropriate nutriment and the weather be favourable.

A Short Study on Cereals

"Cereals" are plants of the graminae family, originating mostly in Western Asia and whose seed serves as food for men and animals. They comprise *wheat, barley, rye, oats, Indian corn and rice.*

The characteristics of this plant are a hollow cylindrical stem with solid nodes at more or less scattered intervals.

The leaves spring from each of those nodes and consist of the *petiole* which surrounds the stem, the *blade* which functions as breathing and digestive apparatus, and the *stipula* which connects the two former. The seed is a dry fruit, called "Caryopsis," whose pericarp is filled with fatty proteic and amylaceous substances in quantities varying with species and varieties.

This seed, in germinating, develops seminal or temporary roots, which absorb enough moisture to liquify the solid matter they contain. They do not nourish the plant, but keep it alive till the real roots are developed. These latter are called "fibrous roots."

INFLORESCENCE

Inflorescence, or arrangement of flowers on the stem, varies with each species. In wheat it is in the form of a spike, that is, the seeds are gathered in clusters of from two to five in an integument called spikelet. This spikelet is firmly attached to each notch of the central branch or rachis of the spike. It consists of two outside empty glumes and of as many flowering glumes and paleae as there are seeds. All these parts combined make up what is known as the hull. In the bearded varieties the flowering glume, somewhat smaller than the empty glume, ends in a beard like that of barley.

The inflorescence of barley is spiked like that of wheat, but it differs from the latter by its empty glumes being narrower. They are called bractea because of their thin elongated shape simulating a fine beard. Each spikelet contains only one grain and in the ordinary varieties the glume adheres to it. In a spike there may be 1 or 3 spikelets on each notch of the rachis. The beard bristles with very fine points which make it disagreeable to handle.

Rye resembles wheat in general appearance, but its inflorescence is a smaller spike than the average variety of wheat. Its peculiarity of developing 4 temporary roots instead of 3 differentiates it from other kinds of cereals. Moreover, its greater resistance to severe climates is attributed to this peculiarity. Its stem, as a rule, is much longer and stronger than that of other cereals.

The floral arrangement of oats differs completely from the three foregoing species

Instead of adhering to the rachis, each spikelet is at the end of a little pedicel of uneven length, which gives oats an appearance of looseness. This mode of inflorscence is called "panicle". The empty glumes are longer and lighter than the flowering ones. In the latter the kernel of the seed is enclosed in the integument without being attached to it, as in barley.

On the whole, there is not much difference between the various kinds of cereals. Consequently apart from certain peculiarities, their mode of cultivation is about the same.

WHEAT

Wheat is the most important cereal for its commercial value and the quality of its products. It constitutes a perfect food for man in the shape of flour and for animals in the shape of meal or bran.

It is cultivated for the following reasons :

1.—Its easy adaptability to soil and climatic conditions.
2.—Its easy and simple cultivation.
3.—Its abundant and quick yield.
4.—Its various present day uses making it an easy food preparation.
5.—Its sustaining power and palatability.
6.—Its rapid improvement under good cultivation.
7.—Its bread-making qualities.

KINDS AND VARIETIES

Of all cultivated grain none has more varieties than wheat. Besides California tender wheats and hard Mediterranean wheats, used especially in making alimentary paste such as macaroni, there is a large variety of wheats grouped under the two headings of **Spring Wheat** and **Fall Wheat.**

In our Province the former is sown from the end of April to the end of May and is ready for harvest from the middle of July to the middle of August.

Fall wheat is sown from the middle of August to the middle of September and is harvested in the following June.

There are good and bad varieties in each of these groups. The fall varieties thrive in certain parts of our Province but the spring varieties are more extensively cultivated.

The varieties contained in these two groups are classed according to the following characteristics:

1.—Bearded wheats.

2.—Beardless wheats.

In each of these classes there are varieties with reddish or with white glumes. The latter may contain a red or a white grain.

Beardless varieties with red grains are the most numerous and most extensively cultivated, but there are good varieties in every group and *environment has more influence on the quality of the yield than variety.*

As a rule, bearded varieties are well adapted to low and rather moist land, and beardless wheats to dry uplands. Red grains command the highest price on the market, because their density of grain produces a better quality of flour.

NECESSARY QUALITIES FOR BREAD-MAKING WHEAT

The external appearance of the plant and grain is not sufficient to determine the quality of a variety. Certain internal characteristics become apparent only as the result of tests covering several years under identical conditions. The qualities which it is most desirable to obtain are:

1.—High yield.
2.—Hardiness and density of grain.
3.—High gluten (1) percentage of superior quality.
4.—Early maturity.
5.—Resistance to drought, rusts, and Hessian fly.
6.—Stiffness of straw.

Several of these qualities are interdependent, such as high yield, hardiness, resistance to diseases or accidents, early maturity of grain and stiffness of straw; while others are antagonistic, as high yield and high gluten percentage. The wheat grower must select a variety possessing a fair proportion of these qualities without unduly sacrificing quality to high yield. The best combination is to choose a high class variety and improve it by proper selection.

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(1) Gluten is an albuminoid matter which plays an important part in the fermentation of dough. It constitutes, from 8 to 16 per cent of the whole grain, according to the variety, soil texture and climate in which wheat is grown. The best gluten is yellow, elastic and porous.

VARIETIES RECOMMENDED FOR THE PROVINCE OF QUEBEC

The tests of varieties in the experimental stations of the Province of Quebec showed that the best adapted wheats to the average conditions of soil and climate are **Red Fife** and **Marquis** among the beardless varieties, and **White Fife** and **Huron**, among the bearded.

Red Fife : — small, clear red, very dense wheat; spike: rather brittle and apt to shell when harvested too dry; glumes: white and beardless; straw: rather stiff. This wheat is hardy and well adapted to our average soil; it matures somewhat later than Marquis. It yields excellent flour for bread.

Marquis : — Bright red wheat with short plump grain ; spike: medium, pointed, beardless, does not shell like Red Fife; glumes: whitish and smooth; straw: stiff and solid.

Marquis usually ripens 4 to 12 days before Red Fife. It is very productive, especially in Saskatchewan where it yields 10 to 50 per cent more than Red Fife. Its great density and high percentage of gluten of good quality make it a first class wheat for bread. It was awarded the first prize during five consecutive years in the international competitions, held in North America for the best bread-making wheat.

White Fife :—Same qualities as Red Fife. Color of grain : somewheat lighter; spike: same average length, but bearded, with reddish rather than white glumes. It ripens at the same time as Red Fife and yields about the same amount per acre.

Huron :—Of more recent origin than the foregoing varieties. Grain: clear amber, well developed and longer than that of Marquis. Spike: bearded; middling in length with reddish glumes. Straw : stiff and somewheat longer than that of the above mentioned varieties.

This variety is very productive and ripens as soon as Marquis wheat. It is resistant and adaptable to every kind of soil. It is not supposed to give as good bread-making floor as Marquis and Red Fife, but its great adaptability to the average soil and its abundant yield make it a very paying wheat.

PLACE IN ROTATION

The proper place for wheat in rotation is after hoed crops. It thus benefits by the fertilizers applied to the soil and by the previous weeding. It is preferable, however, not to sow wheat after Indian corn, because repeated experiments have shown that the yield is not so abundant nor the quality so good. It is better to sow it after root crops or potatoes. The latter are even specially recommended in centres where the cultivation of cereals is the chief revenue of farmers.

SOIL, CLIMATE, FERTILIZERS

The nature of the soil does not affect the quality so much as the yield of the grain. *The best kinds of wheat however, are grown on clay or clay-loam soils, where the climate is cold in winter, cool and moist in spring, followed by a warm dry summer, especially at ripening time.* Though less productive, light soils can give good yields, if they are fertile and well prepared. Districts where the soil is moist and the climate alternately temperate and cold in winter are very unfit for the cultivation of fall wheat owing to the danger of the roots being heaved up.

Fertilizers are unnecessary if the previously hoed crops have been wellfertilized, but if the soil lacks fertility some chemical fertiliser with a basis of phosphoric acid might be added.

PREPARATION OF THE SOIL

It has just been stated that the most favourable soil for the production of wheat is that with a clay texture. Now the preparing of these soils demands very intensive work, as they are compact. Hence fall ploughing is required to pulverize this massive soil and make it porous by disintegrating the fine particles. In the following spring, the soil is then harrowed and rolled, so that it may be in the best possible condition for seeding, that is, when the sub-soil is sufficiently compact and the 2 or 3 inches of surface sufficiently pulverized. Seeding is then done immediately, followed by rolling in order to pack the soil around the grain and produce quick and vigorous germination (1).

EFFECT OF TIME OF SEEDING ON THE YIELD

The question of the date of wheat seeding is much discussed among the farmers of the Province of Quebec, some advocating early seeding, others preferring to wait two or three weeks. Very conclusive experiments to determine this point were carried on some years ago at the Cereal Husbandry Department of Macdonald College. The same variety of wheat was seeded at intervals of one week, at the rate of 2 bushels per acre, in adjoining plots of the same size, and with the same preparation.

The first seeding was done as soon as the soil was sufficiently prepared, that is, when it could be tilled without breaking its texture or when it was dry enough not to stick to the teeth of the harrow. The first year three seedings were made at intervals of a week. The second year a fourth and fifth seeding were added and the third year seeding covered a period of six weeks, at the rate of a seeding a week.

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(1) Says Professor Murray, of Macdonald College, on the selection and preparation of land for wheat cultivation :

"*Land should be chosen that is already in good state of cultivation, such as that which produced potatoes, roots, corn or beans, last year.* These crops usually receive a share of whatever manure is available, and the land after the hoed crop is removed, still holds much of its fertility in a form readily available for the succeeding crop. In addition, this land has had the benefit of summer cultivation, which not only assists in liberating plant food, but also destroys grass and weeds. Such land, if it has been fall plowed, should be in almost ideal condition for wheat. It could be put into good condition even if it had to be plowed in the spring, provided the work was done early.

Should there not be available a sufficient acreage of hoed-crop land, other land partially prepared in the fall could be used.

A clover sod plowed in August or September and well worked during the fall would answer admirably. It would require comparatively little spring cultivation to put it into condition for sowing, it should be fairly fertile and would probably be reasonably free from weeds. A clean clover sod, even if plowed as late as October or November, could be used, but would require more cultivation in the spring. Land that produced peas last year and handled in the same way as the clover sod should, if reasonably clean, produce a good crop of wheat.

If no other land is available, the wheat may be sown on that which produced oats, barley or wheat last year. This practice is not recommended and if it is followed, only the cleanest and best land should be used. If it has not been fall plowed it should be well plowed early in the spring, given a light pressing of manure and thoroughly surface cultivated.

Thorough preparation of the seed bed is necessary in all cases. An effort should be made to put grass and weeds under control and to have the soil firm below and fine on top. The time devoted to preparing the soil is well spent and will bring its reward at harvest time.

It is not advisable to attempt to grow wheat on land plowed out of old sod in the spring. It will pay better to put this land into roots, corn, potatoes or beans, as there is more time in which to prepare the soil before seeding is necessary.

(The preparation of old sod land for wheat growing should begin as soon as the hay crop is removed in July. If it is plowed shallow then, thoroughly cultivated to destroy weeds and grass after the sod has decayed, and replowed somewhat deeper in the fall, it should be in good condition for seeding the following spring)."

The average yield during the six years of the experiment is as follows :

Variety tested: **Red Fife** (1)

Various seedings	Duration of the experiment	Average yield per acre
First..................................	5 years	38.12 bushels
Second................................	5 "	29.69 "
Third	5 "	29.58 "
Fourth................................	4 "	25.93 "
Fifth..................................	4 "	19.63 "
Sixth	3 "	18.93 "

These figures speak for themselves. The effect of delay was felt especially in the second week, since the average yield during five years dropped from 38.12 bushels to 29.69, a difference of 8.43 bushels. These 8½ bushels are sufficient to fully cover cultivation expenses and are lost by a single week's delay.

It will be observed that the yield of the second and third seedings does not vary very much but that with the fourth seeding it drops to 25.93 bushels, a difference of 3.65 bushels.

The fifth seeding gives an average of 19.63, making a new drop of 6.30 bushels as compared with the previous one and in the sixth seeding the drop is only 2-3 of a bushel. Lastly, the most interesting observation is the difference between the yield of the first seeding and that of the last, 20.19 bushels.

Fortunately the farmers of the Province of Quebec do not wait so long before seeding. But how many delay two or even three weeks and through their negligence lose an extra yield which would amply compensate their expenses incurried in wheat growing.

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(1) Extract from Bulletin No. 8, *Best Species and Varieties of grain for the Province of Quebec*, p. 4. *(Date of Seeding).*

The results of this experiment thus fully demonstrate the necessity of early seeding. Fall ploughing, which we have recommended above, besides improving the soil, will enable seeding to be done a week or two sooner in spring.

RATE OF SEEDING

The quantity to be sown varies with the fertility of the land, its preparation, the time of seeding, the quality of the seed and its variety to a certain extent. If the plant is grown under favourable conditions, less seed will be required, the germinating percentage being higher. An average of *one and one half to two bushels of seed per acre appears to give the best results.*

CULTIVATION AFTER SEEDING

Rolling the soil after seeding promotes the germination of the seed by hastening evaporation, but when the plant reaches a height of from 4 to 5 inches, too prolonged evaporation may hinder the growth by exhausting the moisture of the soil. To prevent this dryness, several authorized experts recommend harrowing wheat when it reaches a height of from 4 to 6 inches. This may be done with a spiked-tooth harrow. It will have the effect of breaking the crust of earth formed on the surface, thus lessening the evaporation of the soil. If germination has been abundant, this harrowing will effectuate a useful thinning which will tend to improve the quality of the crop.

HARVEST

Wheat may be harvested when the average crop turns yellow. It must not be allowed to stand till it is too ripe because in most varieties, the spike shells very readily and a large percentage of the grain remains on the field. There is no drawback in cutting the grain before it is quite ripe, provided the sheaves are arranged in stooks well exposed to air and sun.

The best time for cutting wheat varies with the use it is intended for. If the grain is intended for consumption, the crop may be cut before it is perfectly ripe in order to avoid shelling. If, on the other hand, the plot is to be used as seeding for the following year, it is important to let the grain stand till full maturity. The best farm practice is to reserve a portion of the crop for future seeding and let it ripen thoroughly before cutting.

DISEASES OF WHEAT

The accidents to which wheat is exposed during its growth are too numerous to be dwelt upon at length here. The damages caused in certain regions by the Hessian fly were mentioned at the beginning of this bulletin. The losses from this insect are fortunately less frequent nowadays. I shall merely draw the attention of wheat growers to two of the worst enemies of this grain, known as **Stinking Smut** and **Loose Smut.**

BUNT OR STINKING SMUT

Stinking smut is produced by microscopic seeds or spores which adhere to the silky hairs of the grain and germinate with the latter when sown. They become visible when the grain is spiked; the smutty spikes may then be seen by the loose appearance of the glumes in the spike and the oversize of the grain On opening one of these grains called "*smut balls*", the inside reveals a brownish stinking dust.

The spores of the stinking smut attack only the inside or endoderm of the grain, and the infection may extend to a few or to all the grain of the same spike.

REMEDY

One of the most effective remedies is formaline treatment. It consists in immersing the seed for five minutes in a solution of one pound of formaline (forty per cent solution of formaldehyde) in 35 gallons of water. The seed is then dried and sown as soon as possible. Before this operation it is preferable to wash the seed in running water, which carries off the smut balls.

The seed previously piled up on an even floor may also be sprinkled with the solution, care being taken to thoroughly shake up the pile with a shovel. The whole is then covered with previously disinfected sacks, at the end of 3 or 4 days the sacks may be removed, the seed is allowed to dry and sown immediatly.

LOOSE SMUT

Loose smut differs from stinking smut both in its development and in its effects on the host plant. Instead of spoiling only the wheat grain, it consumes the whole floral portion, reducing the spike to a mass of black smut spores. The latter are much smaller than those of stinking smut. They enter the female organ of the flower when the plant is about to fertilize, developing only the following year when the grain produced from this contaminated flower is sown. Like stinking smut it grows without external manifestation until the wheat plant is about to spike The stiff black heads of the diseased plants are then seen standing out in the crop field.

Formaline treatment is useless in this case, and must be replaced by another remedy that is surer to reach the inside of the grain. The seed is immersed from 4 to 5 hours in hot water at 68° F., then it is again immersed in hot water at 112° F. from 15 to 20 minutes; lastly it is immersed in water at a temperature of 129° F. for exactly 10 minutes. The object of these various immersions is to warm the grain gradually, in order that when it is immersed for the last time, the water cools much less and may be more easily kept at the temperature indicated. The grain is then dried before being sown.

This is called "hot water treatment." According to Mr. Güssow, Dominion Botanist, it is the only remedy hitherto recognized as effectual. Owing to the difficulty of its application, formaline is preferred in many cases, but the effects correspond to the value of the treatment.

Against these two diseases, especially loose smut, there are certain preventive measures which contribute to check their development. The most effective is the picking of the smutty spikes as soon as they appear in the field. Care must be taken not to shake the spike while picking it and it is advisable to use a paper bag in which the spike is introduced before being removed. A good practice among certain farmers is to set apart for their provision of seed grain the cleanest and least infected portion of their field. This practice is highly recommended provided that care be taken not to thresh he grain with the threshing machine before previously disinfecting it.

Plots of Marquis and Huron wheat on the farm of the Sainte Anne de la Pocatière Agricultural School, season of 1916: These plots were seeded on May 6th. The wheat on each of them was beginning to ripen when the photograph was taken (July 15th).

OATS

Oats are a valuable plant for agriculture as they adapt themselves to every kind of soil, withstanding both drought and excessive moisture and assimilate whatever nourishment the soil produces. They thrive on recently cleared land, are weed resistant and require less intensive preparation of the soil.

This cereal, one of the richest of the graminae family, contains a high percentage of fatty matter. While inferior to wheat as a food, it is a strengthening and economical diet for human and animal consumption.

KINDS AND VARIETIES

The two kinds cultivated in our country are **Spreading Oats** and **Side Oats.**

In the former, the pedicles or small branches supporting the grains, are uniformly arranged around the central branch giving the panicle an open and loose appearance.

Side oats, on the contrary, have all their pedicles turned to one side and lying close along the central branch.

In each of these two groups we have the *white, black, early or late oats.*

Spreading oats are cultivated more than the others. They are generally more productive and have a much greater value as food than the side oats. Most of the early oats belong to this group.

Side oats are grown chiefly for fodder owing to the high percentage of thick straw and leaves produced. They are not as good as spreading oats for grain production, because their percentage of kernel is not so high.

Here, as in the case of wheat, variety has not to be considered as much as *adaptability.* Some oats, which are very productive and of very good quality in some districts, do not succeed so well in others.

QUALITIES REQUIRED FOR SEEDING OATS

Good seed oats should possess the following qualities:

(1) Earliness;
(2) Hardiness;
(3) Stiffness of straw;
(4) Rust or drought resistance;
(5) High percentage of kernel.

Earliness, hardiness and stiffness of straw are correlative with rust and drought resistance. In fact, most of the growth of early oats occurs previous to drought and thereby escapes rust which oftener attacks late varieties.

By *hardy oats* are meant those which can well endure the inclement weather and defective conditions of the locality where they grow. Thus their straw will be stronger and will better resist lodging which, as everybody knows, makes their harvesting so difficult.

Lastly, what makes oats valuable for food is not the hull but the seed kernel they contain. The larger the kernel and the thinner the hull the greater will be the nutritive value of the oats. Therefore, the varieties with thick hulls must be eliminated and only those with a high percentage of kernel be grown.

VARIETIES RECOMMENDED FOR THE PROVINCE OF QUEBEC

Many varieties have been tried in the Province of Quebec with more or less encouraging results. The great area of territory, the difference in the texture of the soil and in climate, makes it difficult to recommend any single variety. There are, however, among the varieties tested in the experimental stations, some which have proved uniformly well adapted. These are: **Daubeney,** among early varieties; **Abundance, Ligowa** and **Banner,** among the semi-early, and O. A. C. No 72, among the later ones.

Daubeney : Spreading oats. The panicle is smaller than the average: the stiff and rather vertical branches generally have two kernels. The grain is small without much of an appearance, but contains a high percentage of kernel. At the MacDonald College, Ste Anne de Bellevue, this variety has been classed among the most productive although it has not given as good results at other experimental stations. Its chief merit consists in its ripening much earlier than the other varieties. The straw is short, but abundant and of good quality.

Abundance : Spreading oats. The panicle is long and abundant with a contour pyramidal in shape, and semi-horizontal branches containing as many as three kernels. The grain is large and plump, of good quality and with a comparatively thin hull. This variety ripens from 4 to 6 days before the Banner oats and produces a fairly abundant crop. It is becoming more and more popular every year, especially among the farmers in the eastern part of the Province. The straw is long, strong and of fairly good quality.

Ligowa : Spreading oats. The panicle is well developed and abundant. The grain is of good quality, of exceptional size and produces a fairly high percentage of kernel. It has a long and coarse awn which is easily broken when threshing. This variety ripens a little earlier than the Banner one. It adapts itself readily to slighty moist and rich soils but resists with difficulty on soils exposed to drought. The straw is fairly long and of good quality.

Banner : Spreading oats. The panicle is of average size, but well furnished with productive branches. The grain is longer, regular and with a well developed kernel; the hull is thin. This variety is semi-early and adapts itself admirably to the average soils of the Province of Quebec. It is very productive and does not greatly exhaust the soil. It is popular in the Province and throughout Canada. The straw is stiff, abundant and of good quality.

O. A. C. No. 72 : This variety of spreading oats promises much for the southern portion of the Province of Quebec. It comes from a recent selection of Siberian oats made by Professor Zavitz, of the Ontario Agricultural College, Guelph. The panicle is loose and abundant. The grain is well developed and has a higher percentage of kernel than the average of the other varieties. The typical feature of these oats is the pinkish appearance of the straw and panicle at ripening time. It yields an abundant crop, but ripens later than the varieties described above and, for this reason, it is not so recommendable for the northern portion of the Province. The straw is abundant, stiff and of good quality. (1)

PLACE IN ROTATION

Oats are comparatively short-rooted plants, and, as such, should alternate with long-root plants. Their place, therefore, naturally comes after hoed crops: either Indian corn, root plants or potatoes. In a rotation with grain, they should come between wheat and barley, because their roots are longer.

SOILS, CLIMATE, FERTILIZERS

Soil texture is almost indifferent to the growing of oats, provided it is sufficiently fertile and moist. It is otherwise, however, with climate. If it is too dry, the stem of the plant hardens and stops the free flowing of the sap. The grain develops with difficulty, is thin, wrinkled and too light.

It has been ascertained, by an experiment made at the University of Wisconsin, that oats require 504 pounds of water to produce one pound of dry matter. This is due to the abundance of the straw produced and to the rapid growth of the plant. Damp and slightly cool climates are, therefore the best for oats. They likewise adapt themselves to a warm temperature, provided there is a sufficient degree of moisture. *As a rule the climate of the Province of Quebec is very favourable to the growing of oats.*

As to fertilizers, they are not always necessary after hoed crops. But, if the soil is poor, a dressing of from 8 to 10 tons of farm manure will give satisfactory results.

Nitrogen is an important factor in growing oats; but an abuse must not be made of it, because the plant will then have a tendency to lodge.

PREPARATION OF THE SOIL

The soil must be prepared in the same manner as for wheat. Fall ploughing, strongly recommended for all heavy lands, will make the soil more porous by exposing it to winter frosts. On loam or sandy loam soils, fall ploughing in not of such importance, but it always has the advantage of hastening spring work, and consequently of enabling seeding to be done earlier.

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(1) The number of side oats is small. They do not possess the same economic interest as the spreading oats. We therefore deem it needless to describe them in this bulletin.

In some districts the farmers content themselves with harrowing with a disk harrow, but this practice is recommendable only on light soils which have borne a hoed crop in the previous year and are not infested with couch grass. It is important to harrow thoroughly so as to pulverize the earth and make it porous. The packer roller renders great service on soils that are difficult to pulverize. It should be used alternately with the harrow.

When the work of preparing the soil is over, seeding should be done at once and the soil be well rolled so as to pack it around the seed and promote proper germination.

INFLUENCE OF SEEDING TIME ON THE CROP

As oats are, like wheat, a plant whose vegetation is comparatively lengthy, they should be sown as soon as the soil is sufficiently dried and prepared. The experiments made in connection with this, during a period of five years by the Cereal Husbandry Department of Macdonald Collage, have, by the results obtained, clearly shown the nesessity of hastening the sowing of oats in the spring. The yield from the first seeding, namely: that done at the proper time, was an average of 76.28 bushels per acre for the five years. The second seeding, a week later, gave an average of 67.46 bushels, or a decrease of 8.82 bushels. The last one, four weeks later, lowered the average of the crop for the five years, to 65.07, being a difference of 11.21 from the first and 2.39 from the second seeding.

These experiments were made on a soil of uniform texture, fertilized and prepared in the same manner and seeded with 2½ bushels to the acre, that is to say under absolutly the some conditions, except the date of seeding.

This difference between the yield of the first and of the second seeding is alone sufficient to give an idea of the losses suffered by farmers who, without any reason for it, put off their seeding in the spring. The value of the 8.82 bushels lost by a week's delay is more than the amount required to pay the cost per acre for cultivation and seeding.

The following principle must therefore be admitted, namely: *The earlier the seeding, the greater will be the crop, other conditions being favourable.*

RATE OF SEEDING

It is difficult to state the precise quantity to be sown per acre. This varies with the fertility of the soil, its preparation, seeding time, the variety of oats and, above all, the quality of the seed. If the soil is fertile and well pulverized, if the variety is an early one and the seed of good quality, it is not necessary to sow much seed to the acre. On the other hand, the quantity must increase in inverse ratio to the above conditions, especially as regards seed quality.

As a rule, it is better not to sow *less than two and a half and not more than three bushels to the acre.*

CULTIVATION AFTER SEEDING

It sometimes happens, after heavy rains, that the surface (especially that of clay soils) hardens and almost checks the plant's growth. With hoed crops, the matter is easily settled with the help of the cultivator. The remedy is not so easily applied in the case of oats, although the evil is equally injurious. It is then advisable to roll the ground when the plants are from 4 to 6 inches high. This will break the crust and make the surface more porous and permeable to the air.

HARVESTING

It is not necessary in the case of oats for food, to wait until the crop is fully ripe; it can be cut without fear, when the oats turn yellow. It is preferable, however, to let the plot, from which seed for the coming year is to be got, ripen completely. This method, which is followed by some practical farmers, is very recommendable.

Putting the crop in stooks after cutting must not be neglected, because the grain, while lying on the field, is apt to become discoloured and to sprout, if the weather is too damp.

RUST

This is a very frequent disease of oats. It manifests itself by the appearance, on the stem and leaves, of small black or orange blisters of a long or oval shape. The parasites live on the sap of the plant and prevent the full development of the grain. Rust is more general in rainy seasons, because then the tissues are more tender and less resistant to the invasion of the parasites. No very effective remedy against this disease is known. The use of phosphated or potassic fertilizers may be of some use by giving more strength to the young stem.

SMUT

The oat smut is the most disastrous of cereal smuts. It spreads rapidly and leaves nothing but the branches of the panicle and a few discoloured glumes. The infection is the same as in the stinking smut of wheat. Therefore, its spread can be checked by the same treatment. One pound of 40% formaline is mixed with 35 gallons of water. The seed grain is soaked in it for 5 minutes, care being taken to shake it well so that all the seed may be soaked. Then it is dried and covered with previously disinfected sacks. The seed may also be sprinkled with the solution, but this must be done in a very clean place so that the seed grain may not be exposed to be again contaminated after treatment, by the spores in suspension in the air.

The spreading of smut in a crop of wheat may be pretty effectually checked by gathering all the diseased plants in the field. As soon as the smut appears on plants they should be gathered in a paper bag, great care being taken while introducing the smutty head, because of the brittleness of the black masses of spores that escape in dense clouds from the panicle when it is shaken. The number of contaminated grains will be considerably reduced by this process.

Plot of Daubeney oats on the farm of the Sainte-Anne de la Pocatière Agricultural School, season of 1916. This plot was seeded on May 8th. These oats were beginning to ripen when this photograph was taken (July 15th).

Note how early this plot ripened as compared with the adjoining one of Banner oats which has not yet spiked.

BARLEY

KINDS AND VARIETIES

There are two distinct kinds of cultivated barley: **Six-Rowed** and **Two-Rowed Barley.**

The former is so called because the spike consists of six longitudinal rows of grain, three on each side of the rachis. In this variety the spike is usually short and compact.

In two-rowed barley, the spike consists of two longitudinal rows of grain on the rachis. It is longer and thinner than the six-rowed varieties.

Both groups contain beardless and hulless (peeled barley) varieties.

Of all these species or sub-species, the six-rowed barley with bearded and covered grain is the most recommended and cultivated. It matures earlier than the two-rowed varieties and usually gives a more abundant yield. The best varieties for the Province of Quebec are **Manchouria Barley** and **O. A. C. No. 21.**

Manchouria Barley : — A six-rowed variety selected from another variety called Mensury, by Dr. C. E. Saunders, of the Central Experimental Farm, at Ottawa. It has a yellowish kernel, is productive and matures early enough in the average Quebec climate. Its straw is long and stiff.

O. A. C. No. 21—A variety selected from Manchouria barley at the Ontario Agricultural College, at Guelph. It is considered the best six-rowed barley for abundance of yield, quality of straw, weight of grain per bushel and is highly recommended by all experts in cereal husbandry.

Place in rotation, treatment of soil, soils, climate, fertilizers.

Like other cereals, barley must be sown after hoed crops, because it derives great advantage from previous hoeing and weeding. While not so rich, well drained sandy soils give a better barley yield than low and compact soils.

Unlike wheat, barley is practically indifferent to climate. This circumstance gives farmers the advantage of growing barley in cold countries unfavourable for wheat and in districts where oats cannot ripen owing to the reduced period of vegetation.

Plot of *Success* barley on the farm of the Sainte-Anne de la Pocatière Agricultural School. This barley gave good results at Sainte-Anne and promises well for the lower St. Lawrence region. The spike is beardless, solid and fairly long; six-rowed variety. This plot was seeded on May 8th and the barley was almost ripe when the photograph was taken (July 15th).

The fact that barley gives a better yield in sandy soil calls for a more frequent application of farm manure, if the soil is poor. Care must also be taken in preparing the soil so that it may contain as much nutritious substance as possible close to the surface within easy reach of the short barley roots.

TIME AND RATE OF SEEDING

Owing to its short period of vegetation, barley may be sown after wheat and oats. Besides it is more important to prepare the soil well than to sow early. From two to three bushels of seed per acre are required, according to the preparation of the soil, its fertilily and the quality of the seed.

HARVEST

While being harvested, barley, especially brewing barley, must not be left too long exposed to rain. A good brewing barley should have *a thin, clean, wrinkled husk, closely adhering to a plump, well-fed kernel, which, when broken, appears white and sweet, with a germ full and of a pale yellow colour.* Under prolonged exposure to heavy rain, barley tarnishes and turns yellow, its grain not being sufficiently protected by the empty glumes. It may even absorb enough moisture to sprout and become unfit for producing malt, which is extracted from barley to make beer.

DISEASES OF BARLEY

Like wheat and oats, barley is subject to smut. The spores, however, are not the same, being divided into two groups, which develop on totally different lines.

The first, *covered smut,* spreads like stinking smut, infecting the whole spike, but the spores remain enclosed in a greyish integument, which prevents them from contaminating other plants.

Formaline treatment generally reduces the effect of this disease.

The second, *loose smut,* is more disastrous and requires more care. The spores attack the whole floral portion of the spike, reducing it to a sooty mass, like oat smut. The process of infection is like that of wheat smut. The seed should be soaked in hot water in order to reach the disease germ enclosed in the grain.

The precautions or preventive remedies mentioned in the study of wheat and oats (pages 18 and fol. and27) are also effectual against barley smut. In like manner care should be taken to prevent the wind from spreading disease not only to the barley field but also to the adjoining fields.

RYE

Rye belongs to the family of cereals. Its resemblance to wheat is rather striking, but its stem is longer, its spikes are generally smaller and its grain more slender and longer than that of wheat. Its chief characteristic is its hardiness which enables it to resist winter frosts without injury.

Two plots of spring rye, of the *Saatroggen* variety (Swedish rye) and common rye, on the farm of the Sainte-Anne de la Pocatière Agricultural School, season of 1916. Note the extent and uniformity in growth of these two plots. They were seeded on May 8th and harvested on August 3rd (Photograph taken on July 15th)

KINDS OF RYE

The two principal types of rye are **Fall Rye** and **Spring Rye.** Both are cultivated, but the fall variety is more popular on account of its greater yield and of the methods of cultivation which it facilitates.

USES OF RYE

The use of rye on the farm is rather important. It may be used as a green manure for improving soils too poor to grow anything else. Seeding must then be done under the most economic conditions possible, as the growth will still be sufficient to provide good manure.

One of the best uses that can be made of it and which favours its cultivation is the good green fodder it supplies at the beginning of summer. It is well known that one of the great problems in connection with dairy-farming, is the difficulty in securing for every day in the year, a rich and succulent ration to keep up the milk production. For this reason, a certain quantity of grain is sown every year on well-kept farms to make up for lack of pasture. But, when the spring is too dry, grass begins to fail before the green fodder is ripe enough to be cut and be of any use. Fall rye overcomes this difficulty by providing an abundant and very nutritious crop of green fodder in the early days of summer. This green fodder, fed to the cows when grass becomes hard and scarce, amply makes up for the lack of that food, without reducing the milk flow. All dairy-farmers, therefore, should have a crop of rye in readiness for feeding green fodder to their cows at the beginning of summer. In districts where fall wheat is successfully grown, it is mixed with rye to improve the quality of the fodder.

Rye also plays an important part in supplying the inhabitants of certain countries with food. Those who have tasted rye bread have had an opportunity of appreciating the nutritive value of this cereal. It is true, however, that it does not suit all stomachs.

SOILS, CLIMATE

The best soil for growing rye is one of light and sandy texture. If a little farm manure is added, the crop will be more abundant. Rye grows pretty well, however, on clay soils and may be used as a mulch of green manure to make the soil more porous and permeable to rain water.

Rye succeeds best in cold and dry regions. It thrives where wheat, barley and oats are hard to grow. Its manner of growing and early ripening are well adapted to rigorous climates.

RATE OF SEEDING

The quantity to be sown varies between *two and two and a half bushels* to the acre. It is much better to sow more than less in poor or ill-prepared soils.

BUCKWHEAT

Buckwheat is useful on a farm because it lends itself to everything. If a crop in a field does not germinate, if it is too late to sow wheat, barley, Indian corn or any other grain that takes long to grow, buckwheat is sown in its stead and the crop ripens before frost can hurt it. Lastly, if there is a poor or moist piece of land or one not sufficiently prepared, it can be sown to buckwheat with advantage.

The buckwheat plant is of more recent origin than the other cultivated grains, It is classed commercially among cereals, but, from a botanical standpoint, it belongs to a different family, that of the polygonacae. Its growth habit is also quite different. It has but a single stem from which spring more or less numerous branches. Its grain is pyramidal in shape with a triangular base, covered with a strong hull, grey, black or silvery, according to the variety. It begins to blossom at a height of 5 or 6 inches and continues thus until the stem is fully developed. Its rapid growth allows of its seeding being delayed until the end of June. It is even preferable not to sow it too soon because the young plant is very sensitive to late spring frosts. The flowers that develop first are mostly sterile, owing to the washing of pollen from the stamens of the flower when rain is too frequent at fertilization time.

USES OF BUCKWHEAT

Buckwheat is very useful as green manure. Its abundant branches and leaves, constitute a very dense mass of organic matter ploughed under which decomposes in a short time. This, added to the economic conditions under which it can be grown, renders it preferable to all other plants for improving the soil condition.

Buckwheat middling is, according to repeated analyses made of it, one of the richest food for live stock. It must not be used alone, however, because it makes the fat rather soft and flaccid and this reduces the quality of the meat, especially pork. It forms an excellent ration when mixed with other grains.

Lastly, a fact that must not be overlooked is that greenish buckwheat flour is excellent food and is especially relished in the shape of buckwheat cakes.

SOILS, CLIMATE

Nearly all soils are suitable for growing buckwheat, but it prefers a light and well drained soil on account of its taproots which sink to a good depth. In too rich soil, the plant is exposed to lodging which checks the development of the stem and prevents the flowers from ripening.

Climate has a great influence on the growth of buckwheat. If it is too warm or too dry, the plant suffers and grows with difficulty. A temperature rather cold than warm is preferable, as buckwheat grows better than other grains in northern regions.

RATE OF SEEDING

The quantity to be sown varies with the nature of the soil and the manner of seeding. *From three-quarters to a bushel and a half* is the quantity mostly used. If the seeding is sufficient, germination will be more uniform and the growth of the plant will be vigorous, thereby covering the soil before weeds appear. It has sometimes happened that buckwheat sown for the purpose of destroying weeds has been chocked by them.

This was because too small a quantity to the acre had been sown too soon in ill-prepared land. Therefore buckwheat must be given every possible chance to germinate and grow in order to check the development of weeds.

SEED SELECTION

The principles by which one should be guided in selecting seed may be stated as follows:

(1) Choice of variety.

(2) Choice of seed in that variety.

We shall therefore study the qualities that the chosen variety must possess; and then the seed to be used in that variety. We shall then mention the most practical and effective means of making a good selection and conclude by dealing with the question of changing seed.

CHOICE OF VARIETY

The question of choosing a variety for a district is one of the most important and entails constant and lengthy observation. This has contributed, more than anything else, to the establishment of experimental farms throughout Canada. At each of these, a certain number of varieties are tested during from 4 to 5 years. The notes taken in this period enable the varieties recommandable for that region to be determined. The principles upon which the determining of the value of each variety tested is based, are the following:

1. *Adaptation to local conditions.* It is important to choose a variety well adapted to the soil and climate. An early variety is better than a late one for a rigorous climate where the period of vegetation is short. In like manner, certain varieties prefer a light and dry soil, while others adapt themselves to a slightly moist and compact soil.

2. *Productive variety.* The yield of a variety greatly depends upon fertility of soil, upon its preparation and the quality of the seed used, but it is acknowledged that certain varieties, cultivated under identical conditions with others, give a higher yield per acre than the latter because they possess the special quality of being more productive.

3. *Pure variety.* Purity of variety means seed from the same source containing only grains whose characteristic features are identical and capable of producing plants similar in every respect as regards manner of growing and earliness.

The advantage of sowing a pure variety is easily shown. As the grains of which the seed consists, are always of the same origin, they require the same conditions for germination, possess the same power for absorbing food from the soil and can withstand the climate and diseases in the same way. The result is that, conditions of soil being identical, there is a regular and uniform growth during the vegetation season. Moreover, ripening is even in the whole field,which allows of harvesting when the crop is fully ripe without any danger of shelling among too mature plants.

4. *Good feeding and commercial variety.* The quality of the variety, from a feeding and commercial standpoint greatly depends upon the object in view. If it is sought to have good milling wheat, a variety should be chosen whose grain is hard with a shiny cross section indicating a high percentage of good quality gluten. In like manner, in the case of oats intended for food, grain with a thin hull is preferred because the percentage of kernel is higher.

5. *Hardy variety.* The hardiness of a variety is above all important in districts where the climate is unfavourable, especially for fall wheat. Under such conditions a variety should be chosen which will get through the winter without damage by frost and change of temperature.

6. *Variety with stiff straw, and resistant to disease.* Stiffness of straw and resistance to disease are qualities usually found in the same varieties. These are weighty factors to be taken into account in very moist districts where the soil is generally rich in nitrogen.

CHOICE OF SEED IN A VARIETY

Seed selection is not confined to variety. The best always contain a sertain percentage of defective grains unfit for seeding. The conditions in regard to seed selection are as follows:

1. *Vital energy of the seed.* Vital energy or germinating power of a seed is of the greatest importance. This can be ascertained by making it germinate. If from five to eight days after being sown the number of germinated seeds is high, the seed possesses a good germinating power capable of producing vigorous plants. If, on the contrary, the percentage of germinated grains is low, the seed lacks vitality and will produce only weakly and unproductive plants. To test germination, from 100 to 200 grains are put in sand or between two sheets of blotting paper, care being taken to keep them damp and in a temperature of about 75 degrees Fahrenheit. The test may last from 8 to 12 days according to the kind of grain to be tested. With cereals, the percentage of germination should not be less than 90.

2. *The seed should be well developed for the kind and the variety.* Each grain of seed should, besides the embryo (germ), possess a certain reserve whence the young plant will obtain food during the first period of its growth. If this reserve is abundant, growth will be rapid and vigorous. If, on the contrary, it is slight, the plant's development will be slow from the very beginning. This delay will be still more accentuated when conditions of the soil and climate are unfavourable. The result will be a late and weak growth which will be felt throughout the whole vegetation period, even if the weather is most favourable. It is therefore advantageous for the success of the crop to sow only sound seeds, well developed without any exaggeration.

3. *The seed should consist of grains of uniform size.* Uniformity in size causes uniformity in growth, and uniformity in growth gives all the plants the advantage of ripening at the same time. If, on the other hand, the seed lacks uniformity, the crop will be inferior in quality and yield, because the strong and early plants, derived from well formed seeds, check the development of weak plants and ripen earlier.

4. *Seed should be fully ripe.* Seed is known to be sufficiently ripe when it is compact, well developed, and its colour is clear, without exaggerated whiteness in the case of oats. Seeds not fully ripened lack vitality and strength and are not apt to pro-

duce prolific plants. Thus the crop must be allowed to ripen before cutting, especially that which is intended to be used for seeding in the following year.

5. *Seed should be free from damage and disease.* Seeds damaged by dampness or cold do not germinate or, if they do, they cannot produce strong plants. Dampness is the worst enemy of seeds, mouldiness develops in them and when not completely removed, it reduces their germinative power. Seeds clipped or broken during threshing, as frequently happens with barley, germinate with difficulty or not at all, and they should be carefully removed. Lastly seeds from a crop with loose or stinking smut should never be sown unless they have undergone proper treatment. (See pages 18 and fol. and 27).

SEED SELECTION METHODS

Seed selection may be done in many ways; the following are the principal ones:

MASS SELECTION IN THE FIELD

When a registered variety is to be grown and kept pure, the heads should be selected before the crop is cut, by choosing the most uniform in growth and ripeness, showing characteristics most identical with those of the variety sown. This method, recommended by the Canadian Seed Growers' Association is practised on small plots only. In field conditions, it is better to adopt a more expeditious and economical system consisting in choosing, for the next year's seeding, the portion of the crop (an acre or more according to the quantity to be sown) that is freest from weeds, foreign plants, diseases, and most uniform in growth and maturity. The weeds, smutty heads and foreign plants are carefully removed. When the crop is ripe enough it is cut, every precaution being taken to dry the sheaves and not mix them with the remainder of the crop either in the field or in the barn. At threshing time, the machine should be thoroughly cleaned; this grain is threshed first and then stored in a special place free from vermin. All these precautions contribute in a great measure to improving the quality of seed grown on the farm; they also have the advantage of being within the reach of every farmer.

SEED SELECTION WITH A FANNING MILL

Even grain from the best part of the field crop cannot be sown as it comes out of the threshing machine. It should first be thoroughly fanned. This operation is generally performed towards the end of March. It is better to use a fanning mill which selects by weight, that is, by separating the light seeds from the heavy ones. There are, however, graders which separate the seeds by sizes and do good work.

Whatever the machine used may be, all weed seeds, small, badly shaped, broken or discolored seeds should be removed.

This work cannot be done by a single fanning; two, three and even four are needed before the seed can be properly selected. The quantity removed by each of these different fannings varies between 40 and 50 per cent, that is to say that, with 100 bushels, from 50 to 60 bushels of grain fit for seeding are obtained.

HAND SELECTION

Hand selection is not so frequently resorted to as it was before the invention of fanning mills and threshers. It is still necessary however, when special care has to be taken to get choice seed.

Hand selection is generally done with a special table, having one or two openings in the top, on the right and left sides. Two drawers under these openings serve: one for receiving the refuse and the other the good seed. When a double selection has to be made, a third drawer is added, between the first two, which is kept partly open during the work. The first class seed is dropped into this drawer; the second in the left hand, and the refuse in the right hand one.

It would not be practical to recommend hand selection for a seeding of several bushels. It is, however, recognized as the only effective way when it is desired to obtain choice seed whose purity and productive faculties are sought to be preserved. The registered varieties come from seed selected in this way.

CHANGE OF SEED

Many farmers claim that seed should be changed every year or every two years without taking into consideration the state of the seed grown on the farm. Others assert that seed to be sown in light soil should come from grain sown on clay soil and *vice-versa.* Lastly, the partisans of home-grown seed, are opposed to any change of seed except in case of absolute necessity. All these opinions may be right according as circumstances may or may not justify them. But I think that, as a rule, there is too great a tendency to obtain seed from a distant district at a heavy cost. There are, however, certain conditions which necessitate changing seeds.

1. *When it is proved, by thorough and repeated tests, that a seed is better than that grown on the farm and such seed can be obtained without too great expense.* In this case, it is preferable to use the old seed until the superiority of the new one is proved.

2. *When two or more varieties are mixed to such an extent that it is impossible to make a thorough fanning.* There are, in fact, many drawbacks in using mixed seeds of several varieties, as we have seen above.

3. *When the crop has been seriously damaged by bad weather and could not be stored in good condition.* The danger of using seed gathered in bad condition, has already been pointed out. It may, however, happen that an apparently bad crop may give good seed if the necessary steps be taken to make a good selection; but such seed should never be used before making sure of its vitality by a proper germination test.

4. *When seed has been damaged by the threshing or by defective storing.* Here, as in the foregoing case, the question is as to whether it is more economical to do the sorting or to buy new seed and use the whole crop for consumption.

5. *When it is impossible to procure the necessary machines for proper fanning.* The necessity of thorough fanning has already been shown. On the other hand, the Seed Act compels seed dealers to sell only well cleaned seed of high germinative power. It is,

therefore, far better for the farmer to buy seed when he is unable to fan his own.

CONCLUSIONS

These notions are withen the farmer's reach. As we have seen at the beginning, seed selection is the most necessary operation in cultivating the soil, because the abundance of the crop depends upon the quality and germinative power of the seed. Thus it is urgent to be particularly careful and to change seed only when it is absolutely necessary.

The old proverb : **"One reaps what one sows"** is ever true.

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